


JC20 Rec'd PCT/PTO SEP 27 2001

FORM PTO-1390 (REV 10-94)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		DOCKET #: 4925-148PUS
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>				
				U.S. APPLICATION NO. (If known, see 37 CFR 1.5) <b>09/937588</b>
INTERNATIONAL APPLICATION NO. <b>PCT/FI00/00280</b>		INTERNATIONAL FILING DATE <b>30 March 2000</b>		PRIORITY DATE CLAIMED <b>01 April 1999</b>
TITLE OF INVENTION <b>Method and arrangement for changing parallel clock signals in a digital data transmission</b>				
APPLICANT(S) FOR DO/EO/US <b>Harri LAHTI; Marko TORVINEN</b>				
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:				
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). (See Reply to Written Opinion)</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <u>Unexecuted</u></li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol> <p><b>Items 11. to 16. Below concern other document(s) or information included:</b></p> <ol style="list-style-type: none"> <li>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.  <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input checked="" type="checkbox"/> Other items or information (<i>specify</i>): PCT Publication Sheet, Int'l Preliminary Examination Report, Written Opinion, Reply to Written Opinion, Int'l Search Report, PCT Request, PCT Demand, and Notice Informing the Applicant of the Communication of the international Application to the Designated Office</li> </ol>				

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U.S. APPLICATION NO. (if known use 37 CFR 1.5) <b>09/937588</b>		INTERNATIONAL APPLICATION NO. <b>PCT/FI00/00280</b>		ATTORNEY'S DOCKET NUMBER <b>4925-148PUS</b>	
17.[x]The following fees are submitted:					
<b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> Search Report has been prepared by the EPO or JPO .....\$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482).....\$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO .....\$1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .....\$100.00					
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$	860
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	11 - 20 =	0	x \$18.00	\$	0
Independent Claims	4 - 3 =	1	x \$80.00	\$	80
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$	940
Reduction of 1/2 for filing by small entity, if applicable.				\$	
SUBTOTAL =				\$	940
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	940
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$	
TOTAL FEES ENCLOSED				\$	940
Amount to be refunded:				\$	
charged:				\$	
a. [x] One check in the amount of \$ 940 to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 03-2412 in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.					
<b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>					
SEND ALL CORRESPONDENCE TO: <u>Michael C. Stuart</u> Cohen, Pontani, Lieberman & Pavane 551 Fifth Avenue, Suite 1210 New York, New York 10176			 <u>Michael C. Stuart</u> <u>Registration Number: 35,698</u> <u>Tel: (212) 687-2770</u>		

By Express Mail #EL895344425US  
Attorney Docket # 4925-148PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Harri LAHTI et al.

Int'l PCT Appln. No.: PCT/FI00/00280

Int'l Filing Date: 30 March 2000

For: Method and arrangement for  
changing parallel clock signals in a  
digital data transmission

Check box if applicable:

☐ DUPLICATE

**GENERAL AUTHORIZATION FOR PAYMENT OF FEES  
AND PETITIONS FOR EXTENSIONS OF TIME**  
*Submit an original and a duplicate for fee processing*

Assistant Commissioner for Patents

**BOX PCT**

Washington, DC 20231

Sir:

The Commissioner is hereby authorized to credit overpayments or charge the following fees to  
Deposit Account No. 03-2412

- ☒ Any filing fees required under 37 CFR §1.16.
- ☒ Any patent application processing fees under 37 CFR §1.17 not otherwise paid by check.
- ☒ The issue fee set in 37 CFR 1.18 at 3 months from mailing of the Notice of Allowance, pursuant to 37 CFR 1.311 (b) provided the fee has not already been paid by check.
- ☒ Any filing fees under 37 CFR 1.16 for presentation of extra claims.

Respectfully submitted,  
COHEN, PONTANI, LIEBERMAN & PAVANE

By



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Dated: September 27, 2001

By Express Mail # EL895344425US · September 27, 2001

Attorney Docket # 4925-148PUS

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re National Phase PCT Application of

Harri LAHTI et al.

International Appln. No.: PCT/FI00/00280

International Filing Date: 30 March 2000

For: Method and arrangement for changing parallel  
clock signals in a digital data transmission

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents

Washington, D.C. 20231

**BOX PCT**

S I R:

Prior to examination of the above-identified application please amend the  
application as follows:

**In the Claims:**

Amend claim 5 to read as follows:

5. An indoor unit according to claim 3, characterised in that the indoor unit  
(31, 37) constitutes part of a radio link in a mobile telecommunications system.

Add the following new claim:


11 ~~12~~. An indoor unit according to claim 4, characterised in that the indoor unit (31, 37) constitutes part of a radio link in a mobile telecommunications system.

**REMARKS**

This preliminary amendment is presented to place the application in proper form for examination and to eliminate multiple dependency from the present claims. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,  
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27 September 2001

AMENDMENTS TO CLAIMS

5. An indoor unit according to claim 3 [or 4], characterised in that the indoor unit (31, 37) constitutes part of a radio link in a mobile telecommunications system.

Method and arrangement for changing parallel signals in a digital data transmission

5 The invention relates to a method and arrangement for changing parallel signals in the propagation assurance of digital data transmission, particularly for realising the propagation assurance of radio links. Said signals include clock and data signals. The invention is suited to other data transmission connections as well, for instance to connections using optical transmission paths.

10 The quality requirements for a digital radio link are generally known; said requirements are set for example by the ITU, International Telecommunication Union. The quality requirements refer to the reliability and interference-free quality of the transmission. The most important features are usability, error ratio and phase noise. Among the factors that affect the fulfilment of said criteria are hardware malfunctions, weather and changes in the signal path. In order to fulfil  
15 the requirements, it is necessary to provide an equipment and propagation assurance for the radio link. By means of equipment assurance, there is obtained a more reliable usability, and by propagation assurance, there is obtained both a lower error ratio, a lower phase noise and better operational features.

20 Figure 1 is a block diagram illustrating one target of propagation assurance. A public switched telephone network (PSTN) 11 is connected by wires to a mobile switching centre (MSC) 12. The security of the radio link between the switching centre 12 and the base station controller (BSC) 13 is extremely important, wherefore it is generally assured. The controller 13 is further connected, by radio connections which can also be assured, to base telecommunication stations (BTS)  
25 14, 16, 18 and to their antennas 15, 17, 19.

30 The propagation assurance of radio links is realised by means of one or several parallel radio connections. Now in parallel with the major radio connection, there is constructed one or several other backup transmission paths that carry the same information. The transmission paths are preferably different, in order to prevent possible interference caused by the terrain and/or weather changes from affecting both paths at the same time. Among the transmission paths, there is selected the one that has, in the prevailing conditions, a better signal at the station receiving the radio link. The applied criterion for the selection is generally the signal strength, but also the correctness of the parity of the received information. The changing of

the transmission path is carried out by means of a specific changeover device, in a way that is as error-free as possible, by compensating both the dynamic and static phase differences caused by the proceeding of the signals in different transmission paths.

- 5 There also is known the general assurance of digital data transmission by applying forward error correction (FEC). In the data flow, there is added auxiliary information that enables error correction.

10 A drawback with known arrangements is that when changing the transmission path to be received on the basis of a weakening signal, multipath propagation or erroneous bursts are not taken into account, although these can cause errors in the signal.

Another drawback in known arrangements is that the changing of the transmission path to be received cannot always be performed prior to an erroneous reception of the data, because when the error is detected, it has already passed the link.

- 15 Yet another drawback in known error correction methods is that errors cannot always be fully corrected.

20 The object of the invention is to introduce an advanced method and arrangement for changing parallel transmission connections of a data transmission link. In the method according to the invention, the transmission path to be received is changed prior to the passage of errors, and the data transmission of the link remains free of errors, in case at least one of the transmission paths transmits the data as error-free, even if errors occur in others. The error-free quality of the link remains also when an error-free data transmission path rapidly changes over to erroneous mode, and an erroneous data transmission path changes over to error-free.

- 25 This is realised by calculating for the transmission paths, in parallel outdoor units (OU) successive to a common indoor unit (IU), a check sum for the data contained in the interval under observation, said check sum enabling error correction, by checking in the receiving outdoor units the erroneous quality of the data or by correcting correctable errors and by selecting, in the receiving indoor unit, on the basis of a quality factor, representing error-free quality and obtained from the outdoor unit, a more error-free transmission path, in case the currently employed connection causes errors.
- 30



The invention relates to a method for changing parallel signals in digital data transmission, in which method the data flow to be transmitted is divided into several transmissions. According to the invention

- there is selected a primary transmission path,

5 - in the transmission paths there is calculated a check sum for the data flow of the length of the processed section, and the check sum is added to the processed section of the data flow in order to form a data frame to be transmitted,

- in the transmission paths, there is carried out the transmission of the data frame,

10 - correctable errors of the received data frames are corrected, and the error sum in the transmission paths is calculated,

- as an operation common to the transmission paths, the error sum of the selected transmission path is compared with the other paths and when necessary, the transmission path selected as the one to be received is changed over to a path with a smaller error sum, and

15 - the information of the data flow of the processed section of the selected transmission path is conducted to the output cable.

The invention relates to an indoor unit designed for digital data transmission and for the selection of the data flow of parallel signals in digital data transmission. According to the invention, the indoor unit comprises a changeover device for receiving and changing the signal on the basis of an error sum obtained from an outdoor unit.

20 The invention relates to an outdoor unit designed for digital data transmission and for the selection of the data flow of parallel signals in digital data transmission. According to the invention, the outdoor unit comprises a transmitter for transmitting the signal to be transmitted and respectively a receiver for receiving the signal, as well as the calculation of the error sum of the received signal and further the outputting of the information indicating said error sum to the indoor unit.

25 The invention also relates to an arrangement for changing parallel signals in digital data transmission, said arrangement comprising a first indoor unit, antennas for transmitting and receiving both parallel signals and a second indoor unit. According to the invention, it also comprises

30

- a first changeover device in the first indoor unit and a second changeover device in the second indoor unit for receiving the propagation assured data, and

- in both transmission paths, a first and second outdoor unit for processing the data to be transmitted by a modelling algorithm and respectively for processing the data to be received by a checking and error-correcting algorithm.

According to the invention, the changing of the transmission path is carried out always when a better data frame is received from the other path. Thus the changing is carried out frame by frame, by comparing the number of errors occurring in two or more parallel data flows.

10 The changeover device can be fully realised by means of an application specific integrated circuit (ASIC).

The preferred embodiments of the invention are set forth in the independent claims.

The invention is described in more detail below, with reference to the accompanying drawings, where

15 figure 1 is a block diagram illustrating a service environment of propagation assurance according to the invention,

figure 2 is a flow diagram illustrating a method according to the invention,

figure 3 is a block diagram illustrating an arrangement according to the invention,

20 figure 4 is a block diagram illustrating a known signal changeover device,

figure 5 is a block diagram illustrating a changeover device applying a clock signal multiplexer according to the invention,

figure 6 is a block diagram illustrating a clock signal multiplexer according to the invention,

25 figure 7 is a block diagram illustrating another clock signal multiplexer in an arrangement according to the invention, and

figure 8 is a block diagram illustrating a third clock signal multiplexer in an arrangement according to the invention, and

figure 9 illustrates a data frame.

Figure 1 was already dealt with above, in the description of the prior art.

The flow diagram of figure 2 illustrates the operation steps of a method according to the invention. The data flow to be transmitted is divided into two transmissions, and there is chosen a primary transmission path, i.e. a default path 21. In both transmission paths, there is calculated the check sum of a data flow of the length of the section to be processed, for instance by multiplying said data flow by a polynome suitable for modelling, whereafter the obtained check sum is added, 22, to the processed section of the data flow. The processed section of the original data flow and the check sum together form the data frame to be transmitted. The section to be processed defines a single element in the data flow to be processed by the error correction algorithm, such as a frame. On the basis of said element, there is preferably calculated a check sum, which enables error detection and the correction of small errors when receiving data. Errors are detected by calculating from the received section of the data flow another check sum according to the same method, and by comparing the obtained sums. Suitable polynomes are at least some dividing polynomes, the divisional remainder of which is used here.

In both transmission paths, the data frame transmission is carried out, for example via a radio connection 23. The transmission by radio includes signal modulation, transmission, reception and demodulation as well as filtering.

The correctable errors of received data frames, i.e. the number of symbols that is restricted by the precision of the model, are corrected and there is calculated an error sum which advantageously indicates the number of corrected errors, 24. This procedure is carried out in both transmission paths.

As an operation common for both transmission paths, the error sum of the selected transmission path is compared, 25, with that of the other, and when necessary, the transmission path chosen as the one to be received, is changed over 26 to the one that has a smaller error sum and/or that has a better locking of the clock signal. Finally the data of the processed section of the data flow of the selected transmission path is conducted 27 to the output cable.

Figure 3 is a block diagram illustrating the essential elements of a propagation assurance arrangement. An indoor unit (IU) 31 comprises a changeover device (CD) 32 for receiving propagation assured information. The first transmission path comprises an outdoor unit (OU) OU1 33, antennas 34, 35 and an outdoor unit OU1

36. On the right-hand side, there is shown an indoor unit IU 37 that is common for both transmission paths, and a changeover device CD 38 included in said indoor unit 37. The other transmission path comprises corresponding devices 39, 40, 41, 42. The selection of the transmission path for transmissions from left to right is carried out by the changeover device 38, and the selection of the transmission path for transmissions from right to left is carried out by the changeover device 32. The outdoor units 33, 36, 39, 42 comprise means 33A, 36A, 39A, 42A for creating and outputting the signal that indicates the mode of the synchronisation in the clock signal reception and the error sum of the data to be received.

Figure 4 illustrates a prior art changeover device where the pairs of two clock signals CLK and a data signals DATA are changed. The elements outlined by the dotted line 41 are realised by an application specific integrated circuit (ASIC), and they include the following parts: an elastic buffer ELASTIC BUFFER 1 receiving the first signal pair CLK1, DATA1, an elastic buffer ELASTIC BUFFER 2 receiving the second signal pair CLK2, DATA2, a multiplexer REF MUX 44 of the reference clock signal, as well as a correlator and multiplexer CORR & MUX 47. Outside the integrated circuit, there are needed at least an analog low pass filter (LPF) 45 and a voltage controlled oscillator (VCO) 46. The difference in the write and read addresses of the active buffer 42 or 43 is conducted, via the multiplexer REF MUX 44, to the filter 45 in order to control the voltage controlled oscillator 46.

The writing to buffers is synchronised with incoming clock signals CLK1, CLK2, and the reading is synchronised by the output signal CLK of the voltage controlled oscillator 46, which signal is locked to the clock signal CLK1 or CLK2 of the active cable by the signal of the time difference between writing and reading the information, which signal is obtained from the buffer. The cable to be received is determined in the correlator 47, and there are created control signals CONTROL1, 2 for reading the buffers and a control signal CONTROL3 for controlling the multiplexer.

Figure 5 represents a block diagram of a signal changeover device according to the invention in an application specific integrated circuit. The clock signals CLK1, CLK2 of the received signal pairs are conducted to the clock signal multiplexer CLK MUX 51, where the clock signal to be received is selected. Both the clock signals CLK1, CLK2 and the data signals DATA1, 2 are also conducted to the data frame decoding blocks 52, 53, where the signals are used to create for example the following signals: synchronising signal SYNC, bit error (BE) signal, frame

alignment alarm (FAA) signal, and pseudo frame (PF) signal, as well as the data signals DATA\_DF1, DATA\_DF2 decoded from the frames. The outdoor unit OU activates the PF signal while loosening the locking of the clock signal CLK1, CLK2 to be received. In that case the data signal to be transmitted is replaced by a predetermined frame structure. The PF signal is used to indicate, prior to the FAA signal, an error situation in the reception of the clock signal CLK1, CLK2 in the indoor unit, and the FAA signal is only activated on the basis of several alignment errors in received frames. Owing to the pseudo frame structure, the data transmission between the outdoor unit OU and the indoor unit IU can be kept in operation even if the outdoor unit does not receive a proper clock signal. The signals are conducted to the blocks of elastic buffers EB & CTRL 54, 55, where also the selected clock signal CLK to be received is conducted in order to synchronise the data. From the blocks 54, 55, the data signals D1, D2 are conducted, by the data signal multiplexer DATA MUX 56, as a signal D to the decoding block 57. In the decoding block 57, the multiplexer 56 is controlled by the signal SYNC.

Figure 6 illustrates a clock signal multiplexer belonging to an arrangement according to a preferred embodiment of the invention, which multiplexer waits for a suitable clock signal phase in order to change the signals, whereafter the signals are changed. The block 61 detecting the signal pattern "11" sends an active signal when the value of both clock signals CLK1, CLK2 is one. The flip-flop circuits D 62, 63, 64 form a phase shift sensitive coupling, the outputs whereof are conducted to the block 65 detecting the signal patterns "01" and "10". Owing to said coupling, the output of the block 65 is raised to value one after the period of one clock cycle of the clock signal CLK2 has passed from the moment when the polarity of the phase difference between the clock signals CLK1, CLK2 was changed. Thus the phase difference at the moment of a rise in the output of the block 65 is virtually non-existent or 180°. If the signals are cophasal, they can be exchanged almost without a phase shift after a short delay DL 66. The changing of the clock signals by the multiplexer 68 is controlled by the block 67 checking the criteria of the changeover operation, which block 67 receives as input signals a control signal requesting the changeover, a signal indicating the clock signal pattern "11" and a signal indicating the shift in the clock signal phase and delayed by the delay DL. On the basis of said criteria it is known that the signals are cophasal and not in a phase shift of 180°. The purpose of the delay DL is to ensure that the changing of the clock signals is carried out while the clock signals are, from the point of view

of the system, in a static mode, i.e. in mode one. This prevents the creation of a disturbing voltage peak.

Figure 7 illustrates another clock signal changeover device belonging to an arrangement according to the invention, which device comprises, in addition to the embodiment illustrated in figure 6, an analog phase-locked loop (APLL) 71 for synchronising the change, said loop multiplying the frequency of the second clock signal CLK2 by four. The output of the loop 71 is conducted to the block 67 that checks the changeover criteria. Owing to the use of the APLL, the delay DL illustrated in figure 6 is not needed here, because the changeover mode can be delayed by applying a later phase of the signal that was multiplied by four in frequency.

The block 61 indicating the clock signal pattern "11" can be realised for example by an AND gate. The block 65 indicating the pattern "01" or "10" can be realised for instance by an XOR gate. The block 86 indicating the pattern "10" can be realised for example by an inverter plus an AND gate.

Figure 8 illustrates a third clock signal changeover device according to the invention, wherein the phase difference between the signals is detected while the prevailing time difference is no longer than the delay DL. When the clock signal CLK1 is a little bit ahead of the clock signal CLK2, the output mode of the D flip-flops 81, 82 is transmitted as one, but when the phase difference in any case causes a delay DL 83, the output mode of the D flip-flops 84, 85 is transmitted as zero. Now the signals are considered to be sufficiently accurately cophasal, and the phase detector 86 obtains as input the output signals of the D flip-flops 82, 85 in modes one and zero, and gives as output the signal one. The analog phase locked loop 71, the block 67 for checking the changeover criteria and the multiplexer 68 are otherwise operated in similar fashion as in the case of figures 6 and 7, but the block 67 only takes into account the loop 71, the phase detector 86 and the control signals.

The respective elements in the above described drawings 6, 7 and 8 are referred to by the same numbers in order to better illustrate the situation.

Figure 9 illustrates, by way of example, the structure of a data frame. The data frame 91 starts with a locking bit string A, continues with successive pairs of data B / check sum C, and ends with a locking bit string D. The locking bit strings A, D

are preferably similar, and they are used in the frame for locking while decoding the frames.

Let us now observe an example of a propagation assured radio link according to the invention, where the applied error correction method is an RS (63, 59) algorithm.

- 5 With both transmission paths in the outdoor units OU1, OU2, there is calculated a check sum for a data flow of the length of the period under observation, by multiplying the data RS (63, 59) to be checked by a primitive polynome. The check sum is added as a continuation to the data to be checked. Here the period of observation is 354 bits, i.e. 59 bytes, when one byte includes 6 bits. The length of  
10 the data frame formed by the payload information contained by said period plus the check sum is 378 bits, i.e. 63 bytes, of which the share of the check sum is 4 bytes.

Here the created data frames are transmitted via two different radio paths, which are susceptible to disturbances in ways that are as different as possible. Thus possible interference generally causes errors only in one transmission path at a  
15 time.

The received data frames are processed in receiving outdoor units OU1, OU2 by dividing the transmitted data frame by a generator polynome, so that a divisional remainder is obtained. The algorithm that locates errors uses said remainder for detecting errors. In addition to error detection, errors can also be corrected, in this  
20 case no more than two erroneous bytes. The maximum amount of bytes that can be corrected can be raised, by means of interleaving, up to eight bytes. The bytes are corrected, and there is calculated an error sum that indicates how many errors the received data contained. In the outdoor units OU1, OU2 there is created a data frame that contains the corrected payload information and the error sum.

- 25 The indoor unit IU receives from both outdoor units OU1, OU2 a data frame, and the changeover device CD selects, on the basis of the error sum, a better transmission path for the payload information to be further conducted to the output cable.

The invention can be used for example for backing up the links in radio networks conforming to the plesiochronous digital hierarchy (PDH). In that case, for instance  
30 the frequencies of radio links in the GSM network fluctuate within the range 7 - 38 GHz, and even a reading as high as 58 GHz is possible. In this type of application, the payload signal is a data signal of the plesiochronous digital hierarchy (PDH), with a general velocity of 2 Mbit/s or an even multiple thereof, but it may be also

be at least 34 Mbit/s. The length of the link is something between a hundred metres up to as much as several tens of kilometres.

Here an active mode of the signal means that the signal criteria are fulfilled. Thus the signal mode is true or advantageously one. The signal modes can also be  
5 inverted, in which case instead of mode "11", there is observed mode "00". The term 'identical modes' refers, however, to modes "11" or "00", and 'un-identical modes' means modes "01" or "10".

The indoor unit and outdoor unit here refer to the symbolic position of the unit in the system, and this does not restrict the location of said unit in the interior or  
10 exterior of a building.

The number of transmission paths can be two or more.

The invention is not restricted to the above described embodiments only, but many modifications are possible within the scope of the inventive idea defined in the appended claims.



**Claims**

1. A method for changing parallel signals in a digital data transmission over a radio link, in which method the data flow to be transmitted is divided into several transmissions, **characterised** in that
- 5 - there is selected a primary transmission path (21),
- there is calculated a check sum for the data flow of the length of the processed section, and said check sum is added to the processed section of the data flow (22) in order to form a data frame to be transmitted,
- 10 - in the transmission paths, there is carried out the transmission of the data frame (23),
- correctable errors in the received data frames are corrected, and an error sum for each transmission paths is calculated,
- 15 - the error sum of the selected transmission path is compared (25) with the other paths and when necessary, the transmission path selected as the one to be received is changed over (26) to a path with a smaller error sum,
- a clock signal is changed over after waiting for a sufficiently accurately cophasal clock signals, and
- the information in the data flow of the processed section of the selected transmission path is conducted (27) to the output cable.
- 20 2. A method according to claim 1, **characterised** in that the check sum is calculated by multiplying the data flow by a polynome suitable for modelling.
3. An indoor unit (31, 37) for digital data transmission and for selecting the data flow for parallel signals in digital data transmission over a radio link, **characterised** in that the indoor unit comprises at least a changeover device (38)
- 25 for receiving and changing a propagation assured signal on the basis of an error sum obtained from an outdoor unit, said changeover device being arranged to change clock signals after waiting for sufficiently accurately cophasal clock signals.
4. An indoor unit according to claim 3, **characterised** in that the changeover
- 30 devices comprise

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- a multiplexer (51) whereto the clock signals of the signal pairs to be received are conducted, and whereby the clock signal to be received is selected,

- data frame decoding blocks (52, 53) whereto both the clock signals and the data signals are conducted, and where said signals are formed into control signals and data signals decoded from the frames,

- elastic buffer and control blocks (54, 55) whereto the control signals and data signals decoded from the frames are conducted, and whereto the selected clock signal to be received is conducted in order to synchronise the data,

- a data signal multiplexer (56), whereto the data signals are conducted from the elastic buffer and control blocks (54, 55), and

- a decoding block (57) whereto a data signal is conducted from the data signal multiplexer, and whereby the data signal multiplexer (56) is controlled.

5. An indoor unit according to claim 3 or 4, **characterised** in that the indoor unit (31, 37) constitutes part of a radio link in a mobile telecommunications system.

6. An outdoor unit (33, 36) for digital data transmission over a radio link and for selecting the data flow for parallel signals in digital data transmission, **characterised** in that said outdoor unit comprises at least a transmitter for transmitting the signal to be changed and respectively a receiver for receiving said signal, and means (33A, 36A) for calculating the error sum of the received signal and further for outputting the information indicating said error sum.

7. An outdoor unit according to claim 6, **characterised** in that the outdoor unit (33, 36) forms part of a radio link in a mobile telecommunications system.

8. An arrangement for changing parallel signals in digital data transmission over a radio link, said arrangement comprising a first indoor unit (31) for dividing the data flow, antennas (34, 35, 40, 41) for transmitting and receiving parallel clock signals and a second indoor unit (37) for selecting the data flow, **characterised** in that said arrangement also comprises

- a first changeover device (32) in the first indoor unit (31) and a second changeover device (38) in the second indoor unit (37) for receiving the propagation assured data, said changeover devices being arranged to change clock signals after waiting for sufficiently accurately cophasal clock signals, and

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- a first (33) and second (36) outdoor unit provided with means (33A, 36A) for processing by an algorithm that models the data to be transmitted and respectively checks the data to be received and corrects errors.

5 9. An arrangement according to claim 8, **characterised** in that the algorithm modelling the data is a polynome.

10. An arrangement according to claim 8, **characterised** in that the changeover devices comprise

- a multiplexer (51) whereto the clock signals of the signal pairs to be received are conducted and whereby the clock signal to be received is selected,

10 - data frame decoding blocks (52, 53), whereto both the clock signals and the data signals are conducted, and where said signals are formed into control signals and data signals decoded from the frames,

15 - elastic buffer and control blocks (54, 55), whereto the control signals and data signals decoded from the frames are conducted, and whereto also is conducted the selected clock signal to be received, in order to synchronise the data,

- a data signal multiplexer (56) whereto the data signals are conducted form the elastic buffer and control blocks (54, 55), and

- a decoding block (57) whereto a data signal is conducted from the data signal multiplexer and whereby the data signal multiplexer (56) is controlled.

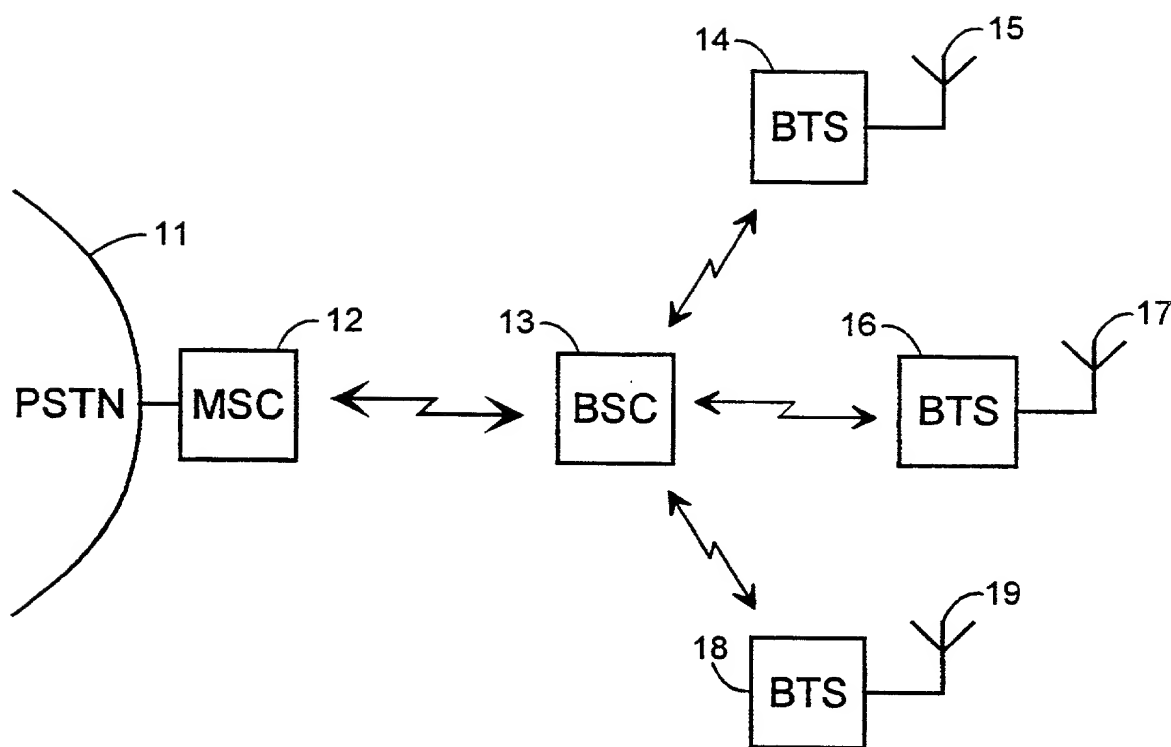


FIG. 1

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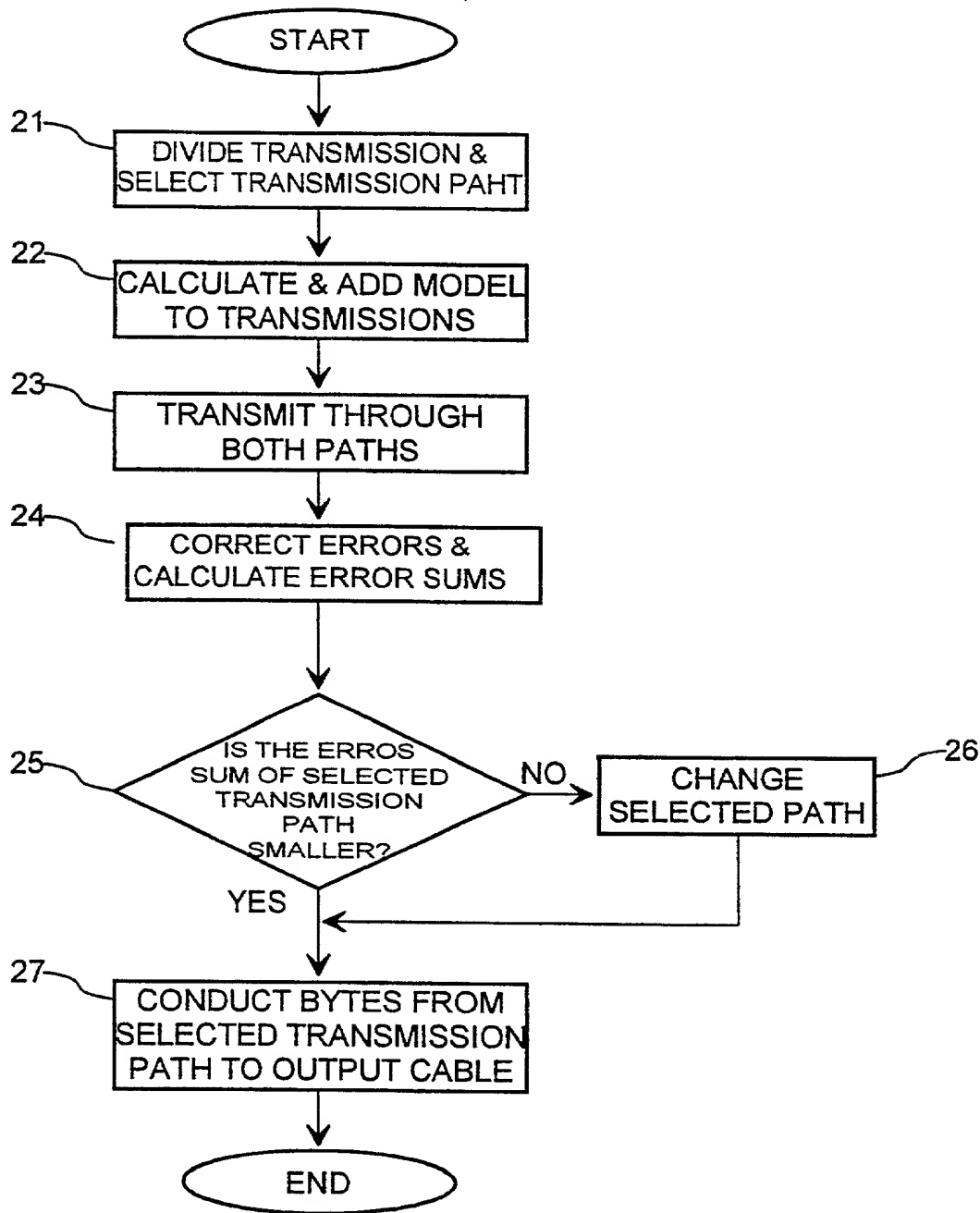


FIG. 2

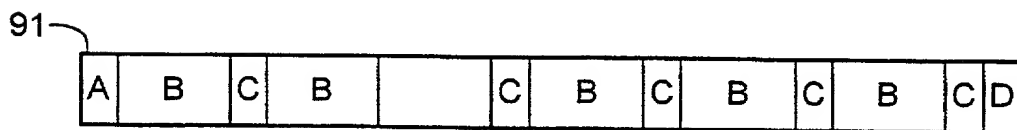


FIG. 9

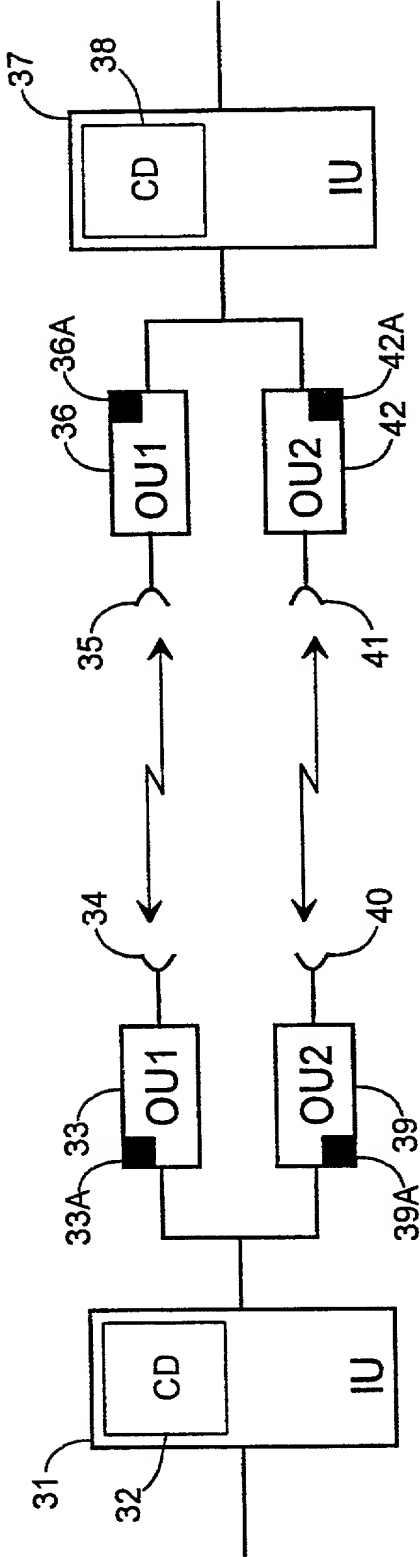


FIG. 3

PRIOR ART

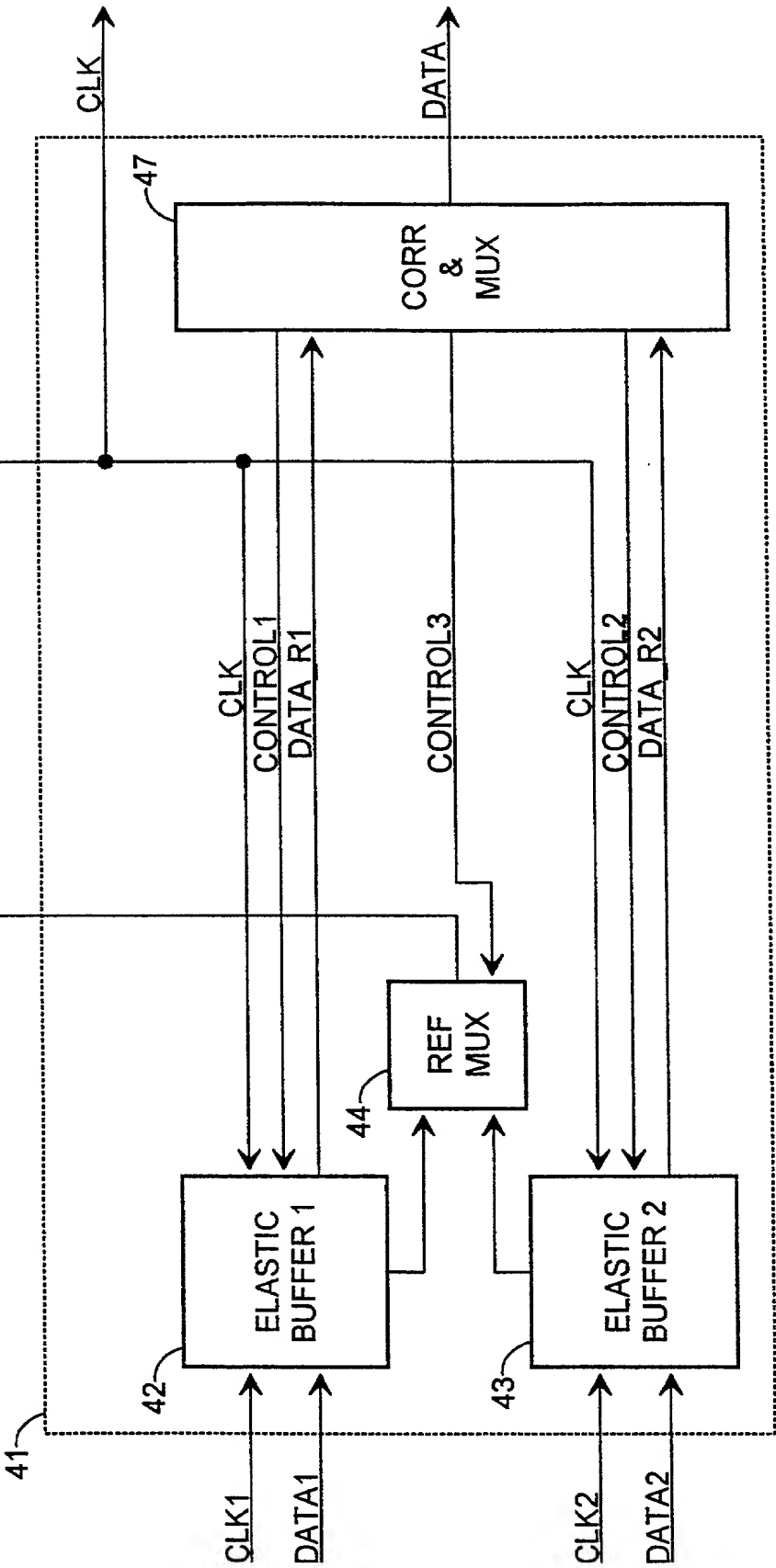


FIG. 4

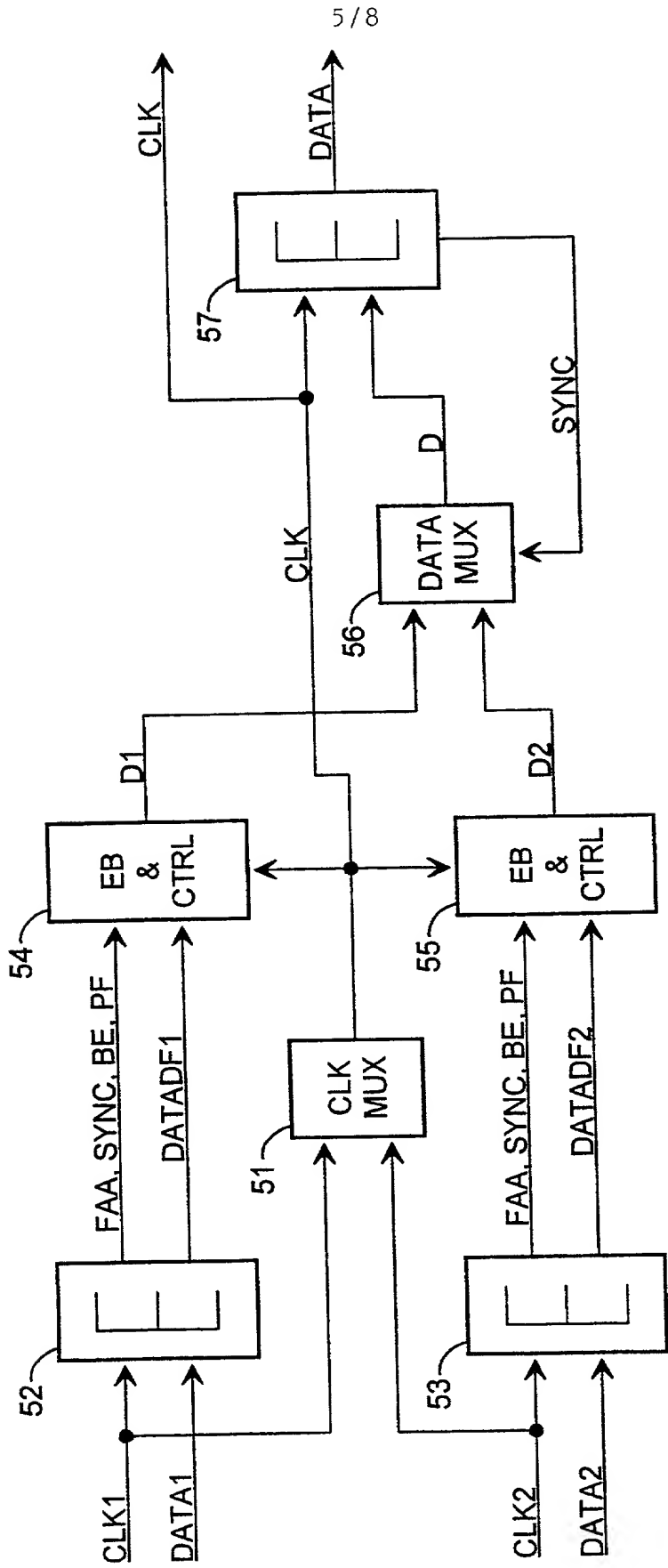


FIG. 5



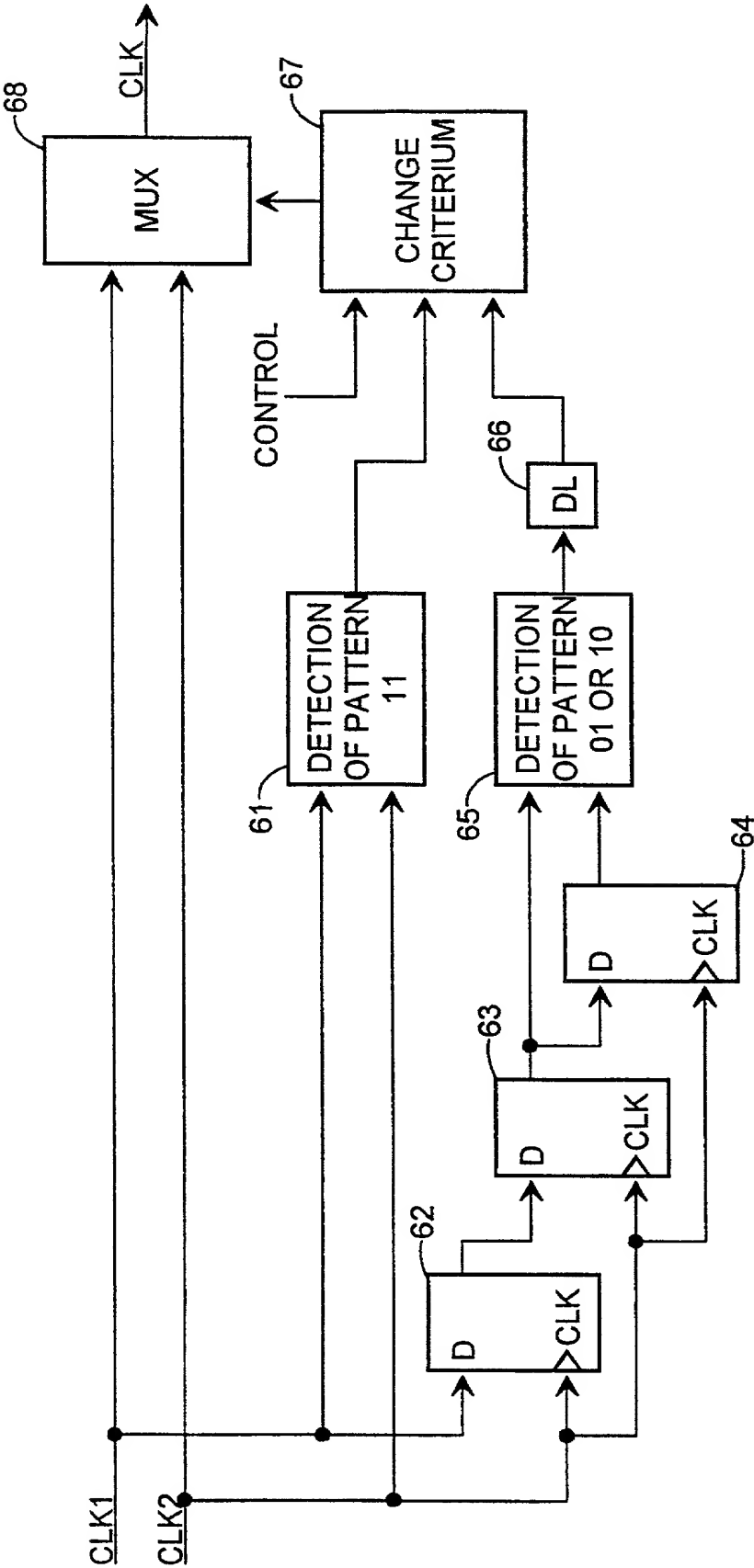


FIG. 6



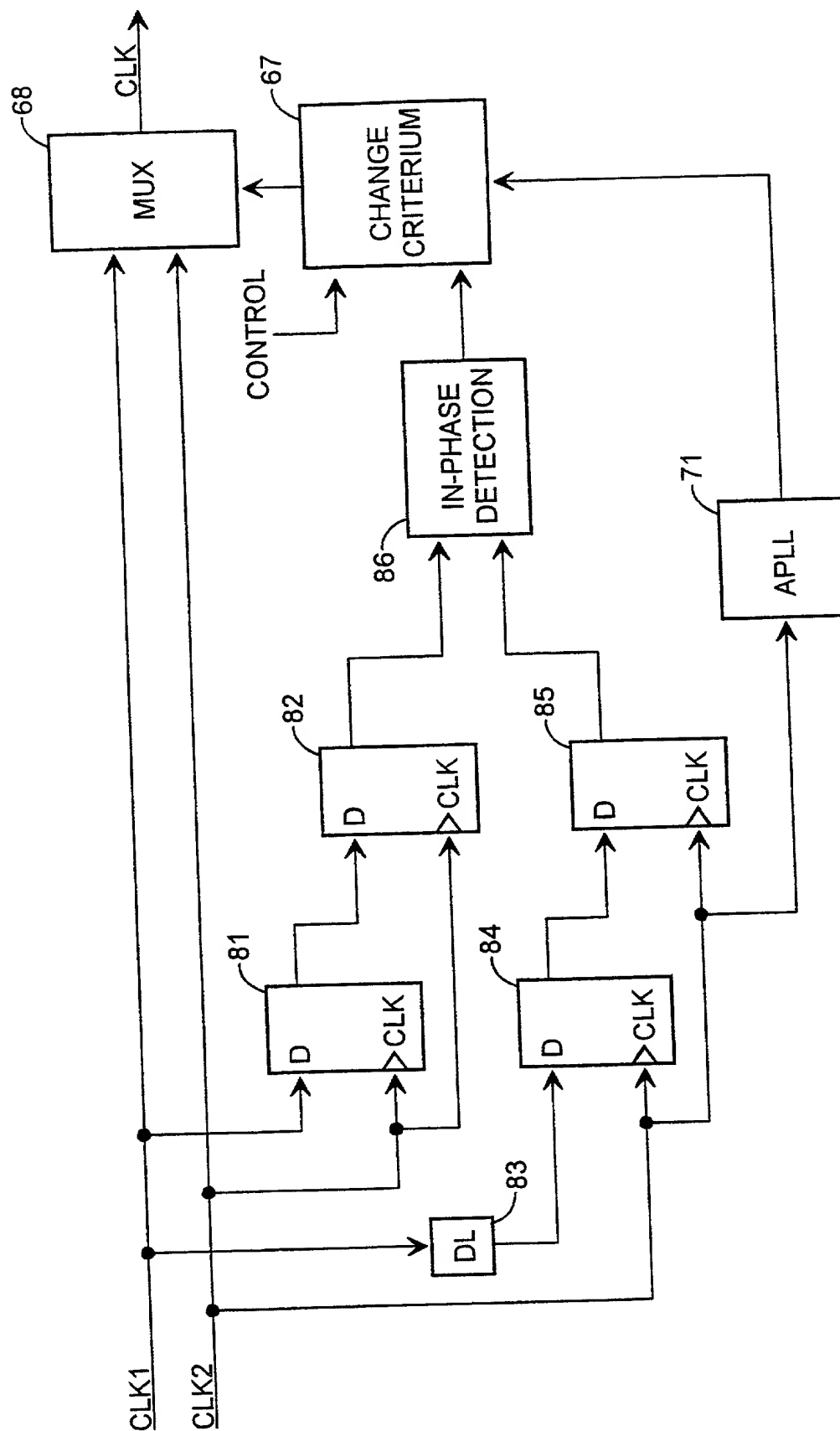


FIG. 8

**COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY**  
Includes Reference to PCT International Applications

Attorney's Docket  
No 4925-148PUS

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**METHOD AND ARRANGEMENT FOR CHANGING PARALLEL CLOCK SIGNALS IN A DIGITAL DATA  
TRANSMISSION**

the specification of which (check only one item below)

☐ is attached hereto

☐ was filed as United States application

Serial No. \_

on \_

and was amended

on \_ (if applicable).

☒ was filed as PCT international application

Number PCT/FI00/00280

on 30 March 2000

and was amended under PCT Article 19

on \_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

**PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:**

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Finland	990739	01 April 1999	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
PCT	PCT/FI00/00280	30 March 2000	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO

<b>Combined Declaration for Patent Application and Power of Attorney (Continued)</b> (Includes Reference to PCT International Applications)			Attorney's Docket No <b>4925-148PUS</b>	
I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:				
<b>PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120.</b>				
U.S. APPLICATIONS			STATUS (check one)	
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		
PCT/FI00/00280	30 March 2000		x	
<b>POWER OF ATTORNEY:</b> As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith ( <i>List name and registration number</i> )				
MYRON COHEN, Reg. No. <u>17,358</u> ; THOMAS C. PONTANI, Reg. No. <u>29,763</u> ; LANCE J. LIEBERMAN, Reg. No. <u>28,437</u> ; MARTIN B. PAVANE, Reg. No. <u>28,337</u> ; MICHAEL C. STUART, Reg. No. <u>35,698</u> ; KLAUS P. STOFFEL, Reg. No. <u>31,668</u> ; EDWARD M. WEISZ, Reg. No. <u>37,257</u> ; JULIA S. KIM, Reg. No. <u>36,567</u> ; VINCENT M. FAZZARI, Reg. No. <u>26,879</u> ; ALFRED W. FROEBRICH, Reg. No. <u>38,887</u> ; KENT H. CHENG, Reg. No. <u>33,849</u> ; ROGER S. THOMPSON, Reg. No. <u>29,594</u> ; GEORGE J. BRANDT, JR., Reg. No. <u>22,021</u> ; F. BRICE FALLER, Reg. No. <u>29,532</u> ; YUNLING REN, Reg. No. <u>47,019</u> ; DAVID J. ROSENBLUM, Reg. No. <u>37,709</u> ; ELI WEISS, Reg. No. <u>17,765</u> ; TONY CHEN, Reg. No. <u>44,607</u> .				
Send correspondence to: <u>Michael C. Stuart</u> Reg. No. <u>35,698</u> <u>Cohen, Pontani, Lieberman &amp; Pavane</u> <u>551 Fifth Avenue, Suite 1210</u> <u>New York, New York 10176</u>			Direct Telephone calls to: (name and telephone number) <u>Michael C. Stuart</u> <u>(212) 687-2770</u>	
201	FULL NAME OF INVENTOR	FAMILY NAME <u>LAHTI</u>	FIRST GIVEN NAME <u>Harri</u>	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY <u>Klaukkala</u>	STATE OR FOREIGN COUNTRY <u>Finland</u>	COUNTRY OF CITIZENSHIP <u>Finland</u>
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Hevontie 25 B</u>	CITY <u>Klaukkala</u>	STATE & ZIP CODE/COUNTRY <u>Finland FIN-01820</u> <span style="float: right;">FIX</span>
202	FULL NAME OF INVENTOR	FAMILY NAME <u>TORVINEN</u>	FIRST GIVEN NAME <u>Marko</u>	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY <u>Espoo</u>	STATE OR FOREIGN COUNTRY <u>Finland</u>	COUNTRY OF CITIZENSHIP <u>Finland</u> <span style="float: right;">FIX</span>
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Kilonpuistonkatu 3 A 16</u>	CITY <u>Espoo</u>	STATE & ZIP CODE/COUNTRY <u>Finland FIN-02610</u>

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)				Attorney's Docket No. 4925-148PUS
2 0 3	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
<p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.</p>				
SIGNATURE OF INVENTOR 201 <i>Hagan Rakt</i>		SIGNATURE OF INVENTOR 202 <i>Min Jee</i>		SIGNATURE OF INVENTOR 203
DATE 10/19/2001		DATE 10/19/2001		DATE